[0012] As giant magnetoresistance effect devices, that of CIP (Current In Plane) structure of the type to flow electric current in film plane and that of CPP (Current Perpendicular to the Plane) structure of the type to flow electric current in the direction perpendicular to film plane are known. The principle of a giant magnetoresistance effect device is a spin dependent scattering at the interface of a magnetic and a nonmagnetic layers, and, in general, GMR is larger in a giant magnetoresistance effect device of CPP structure than in that of CIP structure.

[0013] In such a giant magnetoresistance effect device, a spin valve type is used which inserts an antiferromagnetic layer near one side of ferromagnetic layer, and fix the spin of the ferromagnetic layer. In case of the spin valve type giant magnetoresistance effect device of CPP structure, since the electric resistance of antiferromagnetic layer is higher than GMR film by about two orders as 200 $\mu\Omega$cm, GMR effect is diluted, and the magnetoresistance of a spin valve type giant magnetoresistance effect device of CPP structure is as small as 1% or lower. Thereby, although a giant magnetoresistance effect device of CIP structure is already in practical use for a play back head of a hard disc, a giant magnetoresistance effect device of CPP structure is not yet practically used.

[0014] On the other hand, tunnel magnetoresistance effect devices and MTJ can exhibit so-called tunnel magnetoresistance (TMR) effect at room temperature, such that the magnitudes of tunnel currents in the direction perpendicular to layer surface differ from each other by controlling magnetization of two ferromagnetic layers mutually parallel or antiparallel by the external magnetic field (Refer, for example, to T. Miyazaki and N. Tezuka, "Spin polarized tunneling in ferromagnet/insulator/ferromagnet junctions", (1995), J. Magn. Magn. Mater., L39, p. 1231).

[0015] TMR devices are presently expected for application to magnetic heads of hard discs and non-volatile magnetic random access memories (MRAM). In MRAM, "1" and "0" are recorded by controlling two magnetic layers mutually parallel and antiparallel which make up each MTJ device by arranging MTJ devices in matrix, and applying magnetic field by flowing electric current in the interconnection provided separately. The readout is conducted utilizing TMR effect. However, MRAM has such a problem that, when a device size is made small for high density, the noise accompanying fluctuation of device's quality increases, and the value of TMR is so far insufficient. Therefore, the development of devices having larger TMR is required. As is seen from the Equation (1) above, by using a magnetic material of P=1, infinitely large TMR can be expected. A magnetic material of P=1 is called a half metal.

[0016] Such half metals are so far known from band structure calculation as such oxides as Fe_3O_4, CrO_2, (La—Sr) MnO_3, Th_2MnO_7, and Sr_2FeMoO_6, such half Heusler alloys as NiMnSb and others, and such full Heusler alloys with $L2_1$ structure as Co_2MnGe, Co_2MnSi, and Co_2CrAl. For example, it was reported that such conventional full Heusler alloys with $L2_1$ structure as Co_2MnGe or others can be manufactured by heating a substrate to about 200° C., and making its film thickness to, in general, 25 nm or more by T. Ambrose, J. J. Crebs and G. A. Prinz, "Magnetic properties of single crystal Co_2MnGe Heusler alloy films", (2000), Appl. Phys. Lett., Vol. 87, p. 5463.

[0017] It was recently reported that, according to the theoretical calculation of band structure, $Co_2Fe_{0.4}Cr_{0.6}Al$ in which a part of Cr as a constituting element of a half metal Co_2CrAl is substituted with Fe is also a half metal of L21 type by T. Block, C. Felser, and J. Windeln, "Spin Polarized Tunneling at Room temperature in a Heusler Compound—a non-oxide Materials with a Large Negative Magnetoresistance Effect in Low Magnetic Fields", Apr. 28, 2002, Intermag Digest, EE01. But its thin film and tunnel junction have not been fabricated. Consequently, like conventional other $L2_1$ type compounds, it is not known experimentally at all whether its thin film shows half metal characteristics or large TMR properties.

[0018] However, though such a spin injection method is hopeful as a spin reversal method of nano-structure magnetic material in future, the current density required for magnetization reversal by spin injection is as quite high as $10^7 A/cm^2$ or higher, and this aspect was a practical problem to be solved.

[0019] Here, the present inventors discovered that magnetization reversal by spin injection can be obtained at lower current density by flowing electric current from a ferromagnetic layer via a nonmagnetic metal layer or an insulating layer provided separately to the triple layer structure in which two ferromagnetic layers are mutually connected antiparalel via a nonmagnetic metal layer.

[0020] Further, the present inventors also discovered that the functional effect similar to that mentioned above can be obtained by using, in place of the above-mentioned triple layer structure, a double layer structure consisting of a ferromagnetic free layer and a nonmagnetic layer, and a triple layer structure consisting of a ferromagnetic free layer, a nonmagnetic layer, and ferromagnetic layer.

[0021] Also, though giant magnetoresistance effect devices of CIP structure practically used at present for play back heads of conventional hard discs are being made microfabrication for high record density, insufficiency of signal voltage is predicted as a device is micro-fabricated, and higher quality of giant magnetoresistance effect devices of CPP structure is demanded instead of giant magnetoresistance effect devices of CIP structure, which so far has not been realized.

[0022] Except for the above-mentioned half metal Co_2CrAl, half metal thin films are fabricated, but it needs for it to heat a substrate at 300° C. or higher, or to anneal at 300° C. or higher after film forming at room temperature, but there have been no reports that the so far fabricated thin film is a half metal. The fabrication of tunnel junction devices using these half metals has been partly attempted, but TMR at room temperature is in all cases unexpectedly low, such that its maximum value is at most between 10 and 20% of the case using Fe_3O_4. As has been seen, the conventional half metal thin film requires the substrate heating or thermal treatment to attain its structure, and surface roughness increase or oxidation thereby may be considered as one of the causes for no large TMR attained. On the other hand, the thin film differs from bulk material in that it may not show half metal characteristics on the surface, and the half metal characteristics is sensitive to composition and the regularity of atomic alignment. The tunnel junction in particular has difficulty to attain the half metal electronic state at its interface. This is regarded as the cause for large TMR not